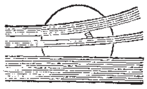
But, however far the supply exceeds the demand, there is always room for what is thoroughly good, especially if it has improvements that its predecessors lack. Though every author is apt to think his pet methods are the very best, and more or less inclined to regard his fads as steps towards perfection, if not indeed its full realization, there are a few who take a sounder view of things, and care nothing for novelty for its own sake. The author of the volume before us has shown that he is one of the few. This book is of sterling value, and will be welcomed by the teacher of elementary chemistry as a guide for his students that he will have pleasure and full confidence in placing in their hands. The volume is well got up, printed in clear type, and illustrated with a sufficient number of excellent diagrams, many from original drawings made by the author. Its 272 pages are not crowded with information or anything else, but the facts included are clearly described in a readable and concise manner. In scope, the book includes the principal non-metallic elements and their chief compounds, followed by the more important metals and their salts. The selection is good and not novel. The periodic law is briefly referred to, and the last eighteen pages are occupied with the chemical physics that it is usually considered well for elementary students to master, such as the relation between specific heat and atomic weight, critical temperature, diffusion of gases, effects of temperature and pressure upon gases, and so on.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Alpine Haze.

PROF. TYNDALL has done good service by drawing attention to Alpine haze, and is quite right in adding that it appears in horizontal layers. Such is its common form, but I have also observed a vertical part of it connecting two horizontal striæ rendered conspicuous by concealing portions of a setting sun, just as thick boards might do. On another occasion I saw a rough column of it towards the north-west at a supposed distance of three or four kilometres. A few hours later, while I was noting down the phenomenon, a native exclaimed that it had changed its position, and on looking north-west I could see no trace of it, a column similar in size and distance being then in the north-east. It towered above my level on a rolling plain 2300 metres above the ocean. In another place I have seen it at a height of 3600 metres.



Setting sun observed February 16, 1846, at Garuqqe, in lat. 8° 0'·6, long. 36° 51', at an altitude of 2175 metres.

Although generally overlooked by meteorologists, this phenomenon has a special name in warm countries. Portuguese call it *neblita*; in Spain it is mentioned as *callina* or *calina*, and Basques name it *lañoa*. Nowhere have I seen it so frequent and thick as in Ethiopia, every different language of that wide region having a special word to express it. The Amara call it *tigag*; the Oromo, or Galla, *qayota*; the Tigray, *taqa*; while old Ethiopic employs the term *qobar*. I have used the latter in my published accounts, because *brume* in French and *haze* in English are generic and not specific names.

Qobar is gray, and of a livid hue when intense, verging sometimes to blackness. The Gascon-speaking population in the Pyrenees call it *bruma terranera*, *i.e.* earth-haze. Its edges are not jagged, like those of clouds, but quite smooth. At Quarata, in 1845, when I was at the level of Lake Tana, the Island of Daga, which rises suddenly 140 metres above the water at an angular height of 16′ and a distance of 11·6 miles, was visible only by 4′ or 5′ of its upper part, the lower 11′ or 12′ being concealed by *qobar* thicker than usual, and seemingly spread on the lake. I have seen it often on the Red Sea, and sometimes even here in the Bay of Biscay towards the north.

Qobar is the surveyor's foe, and has made me lose several important bearings. It blurs the landscape, diminishes estimated distances, and in Ethiopia is often so thick that no feature of a country is visible beyond the space of a mile.

Fifteen years ago I published in my "Physique du Globe" all that I know about *qobar*. In Germany it goes by the name of *Heiderauch*, or by six other words all ending in "*rauch*." Ethiopians also compare it to but distinguish it from smoke. When commenting on chapter x. of Exodus, their native professors say that the darkness mentioned in verse 22 was an intense *qobar*, and go on to explain that the light enjoyed by the Children of Israel is fully borne out by the fact of *qobar* being sometimes prevalent in one place, yet absent in its neighbourhood. I have noted several instances of this partial occurrence. Without quoting them, I may mention that, according to my working hypothesis, *qobar* is only dry air, visible because in large quantity. On the other hand, astronomers well know that very moist air is the most transparent.

Natives are swarthy in countries where *qobar* abounds. Does it darken man's skin? At all events it is worth while to draw some hundred litres of it through suitable reagents. Chemists could thus test Kaemtz's notion that it is always smoke.

ANTOINE D'ABBADIE (de l'Institut).

Abbadia, Hendaye, November 10.

P.S.—I forgot to mention that, after crossing the three layers shown by the figure, the setting sun crossed two other layers, and finally disappeared behind the lower stratum of *qobar*, then 3° or 4° above the horizon.

Rankine's Modification of Newton's Investigation of the Velocity of Sound in any Substance.

PROF. EVERETT'S letter (November 8, p. 31) calls attention to a difficulty which is apparently felt by students over the attempted elementary method of deducing the general expression for the velocity of sound given in Maxwell's "Heat." Advanced students need feel no difficulty of the kind, because they arrive at it by another path; but inasmuch as the Rankine method seems the easiest available to intermediate students, it is desirable as a matter of pedagogy to put it in its simplest form; and so I venture to quote here the plan I have for some time adopted.

First lead up to the subject by considering the velocity of a hump on a stretched string. Explain the plan of imagining the string to move along at the same pace as the hump, but in an opposite direction, so as to keep the hump stationary in space, obtaining the velocity necessary to do this by equating the normal compound of the tension to the centrifugal force—

$$\mathrm{T} \cdot \frac{ds}{r} = \frac{\lambda ds \cdot u^2}{r}, \qquad \text{or } u = \sqrt{\frac{\mathrm{T}}{\lambda}},$$

where T is the tension, and λ is the linear density of the string; and then actually show the experiment—running a light loose flexible endless cord on a pulley, and making a hump on it. The tension in a loose whirled endless cord free from gravity being that due to the centrifugal force only, viz.—

$$\mathrm{T} = \frac{\lambda ds \cdot v^2}{r} \cdot \frac{r}{ds} = \lambda v^2,$$

it follows that $v = u$, and so the keeping of the hump still is automatic, except for a slight interference by the weight of cord hanging below the hump. This interference being less and less notable as the hump is initially made nearer the bottom of the loop of cord.

Next explain, and illustrate by moving diagrams, the simple harmonic motion of the particles of a medium conveying sound-vibrations.

Then proceed to consider a longitudinal pulse travelling along a substance contained in a tube of unit area, and imagine a wind of the substance blowing through the tube in the opposite direction with such a velocity, U, as just to keep the pulse stationary in space.

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Except for an unessential disturbance due to friction, the pressure all through the tube is uniform so far as the wind-motion is concerned.

Erect across the tube a couple of imaginary partitions, and watch the substance streaming past them. The state of the substance at either partition, whatever it may be at one instant, remains permanently the same always; hence the mass of substance inclosed between the two must remain permanently the same—for it cannot be always steadily increasing—and therefore *the mass of matter flowing through any one plane is constant.*

In future attend to one of the planes only, and call the density of the substance at this place ρ. The plane may be at or near a condensation, it may be at or near a rarefaction, or, again, it may be where the substance has its ordinary density; whatever the state of the substance there, the same it remains. The longitudinal-pulse motion of the particles of substance (which has previously been illustrated and discussed at length) is superposed upon the wind-motion; and if we followed any one particle along the stream we should see it simply oscillating with a simple harmonic motion—

$$x = a \sin nt, \quad \text{or} \quad v = an \cos nt,$$

having at any instant the velocity v.

But we are not going to follow a single particle down stream; we are contemplating a procession of particles as they successively pass the fixed partition, and at the instant of passage they are all in a definite phase of their motion—they all have the same definite velocity, v, as they pass, in addition to their general wind-velocity, U. The vibratory velocity v may be in the same direction as U, or it may be in the opposite direction; it may have any value between $\pm na$, of course. So the resultant velocity of each particle as it passes the fixed partition is algebraically $U + v$. This represents the length of cylinder of substance passing through the partition per second; and, since the partition is of unit area, the mass of substance flowing past it per second is

$$m = (U + v)\rho, \text{ and is constant} \quad . \quad . \quad . \quad . \quad (1)$$

This of itself is an interesting result; for it shows that at the middle of condensations, where ρ is a maximum, v must have its greatest negative value; and the particles are therefore all in full swing back against the wind (*i.e.* travelling with the sound-pulse) at the middle of every condensation. At a rarefaction, v has its greatest positive value, and the particles are swinging with the wind (against the sound-pulse). Only at half-way places, where the density of the substance has its average or undisturbed value, are the particles quiescent as regards the sound-pulse.

Next consider the dynamics of the matter, and the force which must act to vary the motion of the particles.

If the pressure were the same on either side the partition, there could be no change of velocity for the particles as they pass. The charge of velocity, $d(U + v)$, or dv, must be due to a difference of pressure existing on either side the partition; and if the slope of pressure $\frac{dp}{dx}$ is positive, the pressure is greater on the lee-side of the partition than on the windward side, and so the acceleration $\frac{dv}{dt}$ will be negative. Hence, equating the force acting and the momentum generated by it per second,—

$$dp = - mdv \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

This equation, along with equation (1), solves the problem, and determines the velocity U.

Differentiating (1)—

$$(U + v)d\rho + \rho dv = 0.$$

Rewriting (2) by help of (1)—

$$(U + v)\rho dv = - dp.$$

Substituting for $\rho a v$ from one of these into the other, we get—

$$(U + v)^2 = \frac{dp}{d\rho} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

This equation shows that $\frac{dp}{d\rho}$ is by no means constant all through the substance. It is greatest wherever v has its maximum positive value—that is, at the centre of every condensation; it is least at the centre of every rarefaction; it has an average value in the undisturbed portions of the medium, and it is there equal to U^2.

Hence we learn that the value of U is determined by calculating the ordinary value of $\frac{dp}{d\rho}$ for the medium in its uncompressed and unrarefied state.

So—

$$U = \sqrt{\frac{dp}{d\rho}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

This is the velocity with which the substance must flow *through the tube in order to keep the sound-pulse stationary:* this, therefore, is the velocity of sound in it.

The result is general, and applies to all substances. But for gases it may be written more explicitly by help of their characteristic equation $\frac{p}{\rho} = RT$, and their adiabatic condition $p \propto \rho^\gamma$: viz.—

$$U = \sqrt{\gamma RT} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

T here means the undisturbed temperature of the gas, but if one chooses to allow the equation to follow the fluctuations of temperature ($\pm t$) adiabatically produced in the condensations and rarefactions, one must write the more general form—

$$(U + v)^2 = kR(T \pm t) \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

which gives us the relation between fluctuation of temperature and vibrational velocity. We may also write it—

$$\rho^2(T \pm t) = \text{const.} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

which shows the connection between the elevation or depression of temperature, and the density, at any part of a sound-wave.

Speaking as a teacher, I believe one reason why we fail to make things clear is, because we are often in too big a hurry. One's natural tendency is to give such an investigation—as this, for instance, in Maxwell's "Heat"—in a few lines on the blackboard, taking perhaps half an hour or less over it, and forgetting that it embodies in concentrated form a great deal of difficult thought, though the actual mathematics may be simple. Gradually I am learning not thus to scamper over the ground, but to lead up to a thing in two or three or even more lectures, and then to devote a whole hour to the thing itself. By this means, students may ultimately be got to grip and feel the thing as a whole, instead of having to ascend step by step to it; but it is hopeless to expect them to thus grasp it straight off; and even if it were possible, it would not be really desirable for various reasons. The attempt to hurry them into the comprehension of difficulties leads them, I believe, into a vague notion that everything is hazy and half unintelligible. The best thing we can do for them is to get them to see some few things luminously, so that they may not feel inclined to rest satisfied with half-knowledge in other instances.

OLIVER J. LODGE.

November 12.

P.S.—Since writing the above, I have referred to Prof. Everett's note A in Deschanel, and have found it excellent, like all his notes; he happens to have employed just the same means as the above for obtaining equation (1), but for the latter part I prefer my statement. I trust no one will imagine that the above contains anything more than a way of putting things to students.

The slip of a wrong sign in Maxwell I had not distinctly noticed, but the simplest statement of it seems to be that in obtaining the second equation he has put, for the change of velocity of each particle as it passes a plane, du instead of $d(U - u)$; that is, the change of absolute instead of relative velocity.—O. J. L.

A Simple Dynamo.

I VENTURE to send you a brief description of a simple electromagnetic instrument which I have recently devised for illustrating the principle of the Gramme ring.

Two pulleys, A, B, having semicircular grooves, are mounted, as shown in the figure, on a piece of board; round the two wheels is stretched a continuous coil of copper wire; a horse-shoe magnet is placed with its poles close to the vertical parts of the coil; the wheels are connected to the terminals t t': when the wheel A is rotated the whole coil moves, and a steady current is at once generated, which flows from terminal to terminal when they are

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